University of Utah
Department of Mathematics

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A f t e r m a t h

From the Editors

This year's editors of the Aftermath are Peter Alfeld and Angie Gardiner. We hope you will find this math department newsletter interesting, and maybe even sometimes entertaining or instructive. Please contact either of us if you have something you think may be of interest for inclusion. You never know, we might even engage in a piece of investigative journalism!

Personally, we'd like to welcome all the newcomers to our department. Please don't hesitate to contact one of us if you wonder how things work here, or what to do. We may not know ourselves, but we can probably point you to the right person to find out.

We are a large department, but generally a happy bunch, and we seem to be headed for a fruitful and enjoyable new year. We hope that you will enjoy mathematics and this newsletter!

--Peter and Angie.

Welcome from the Chair

by Graeme Milton

I hope you all enjoyed the summer. The good news is that there were no floods to report. Arctic temperatures were reported in LCB but we hope to rectify that. The fantastic news is that the renovation of the attic of LCB is due to begin soon and should be finished by Spring semester. This will be a great environment for next year's first year graduate students, current and future REU students, and as a general area for faculty and students to hang out in and discuss mathematics. The renovation of the attic was largely made possible by a $75,000 gift from the Dumke foundation, which was supplemented by a generous further gift of $50,000 from the Dumke family themselves, and by substantial funds from the university. It is rewarding to see such significant donations being made to the university for the development of our department. One has to look no further than our bustling Rushing Mathematics Student Center to see the benefits of donations by thoughtful benefactors (in that case the Eccles Foundation).

On the subject of donations I would like to especially thank everyone (alumni, students, faculty and other friends of the math department) who contributed gifts to the department last year, for various purposes such as the "save our scholarships" (SOS) fund. A major portion of these donations comes from people from within the department, so if you haven't done so already please think of the department, along with the various charities, religious, political, or other non-profit organizations that you contribute to regularly. In particular if you say to yourself "wouldn't it be great if the department had money for X," please do not hesitate to donate money to the department stipulating that it be spent on X. (So long as X is not a 50 foot high photograph of yourself or your dog that you want mounted on the side of our building.)

The department has been especially successful at obtaining grants these past few years. It is great to see that all our new tenure track assistant professors (Ken Bromberg, Chris Hacon, Y.P. Lee, and Peter Trapa) are principal investigators on grants. Also, we are one of the few departments in the country to have both IGERT and VIGRE grants.

There are many things to be pleased about. Maybe I am biased, but I think we have one of the best staff in the university. This includes the accounting, computing, secretarial and other support staff. Our math center is a hive of activity. The REU's (research experiences for undergraduates), and high school programs have been tremendously successfully and it is wonderful to see the increase in our math majors. We are among the 25 group I math departments in public institutions nationwide (see the article on page 801 of the latest AMS Notices). We have a continually increasing number of graduate stu-

dents, assistant professor lecturers and postdocs (VIGRE, IGERT, or other) and they add a lot to the vitality and research of the department. Our VIGRE grant is up for review this year but I think we are well placed to ensure its continuation. May the upward momentum continue!

From the Assoc. Chair

by Nat Smale

Hi All...Welcome back to the new school year. I am the new associate chair, taking over from Peter Alfeld who held the position for the last six years. Although a number of people have given me their "condolences" upon hearing that I was taking the job, it has actually been fun, especially meeting everyone in the department. As associate chair, I'm in charge of a number of things, mainly related to teaching and space, such as teaching assignments, office assignments and scheduling. If anyone wants to discuss anything having to do with these issues (or anything else), feel free to stop by my office, JWB 236. I'd like to thank Peter for all of his help in getting me started (and, of course, for doing such a great job in the past six years). I've actually gotten quite a bit of exercise going up and downstairs to his office!

The Case is Different Here

by Chris Roberts, USAC Chair

"I am happy about the contact and friendship of mathematicians … they have often given me new ideas, and sometimes there even is an interaction between us."- M.C. Escher.

Escher, an illustrator of scientific publications, seemingly was surprised at how closely mathematicians resembled socially engaging beings. It is understandable though. Escher, like most outsiders, was unable to access the culture of mathematicians. He, after all, was an artist, not a mathematician. Many undergraduate students also cannot access the culture of mathematics. They are students, not mathematicians. Additionally, at many academic institutions the culture expressly denies access to the uninitiated undergraduate. However, the case is different here.

Our administration, faculty and staff encourage undergraduate access and participation in mathematics through research opportunities, colloquia, tutoring, open discussion and general accessibility. In addition, the Undergraduate Student Advisory Committee (USAC) has established as its primary goal for the upcoming year even greater undergraduate access to the culture of mathematics. By offering undergraduates an array of social and professional activities, the USAC is seeking to engender a greater sense of community within the department. The committee believes that such a community enhances the college experience, fosters the sharing of ideas, creates networks for future employment and research opportunities, and considerably strengthens individuals' abilities to interact (even with artists).

The Math USAC encourages you to take advantage of the opportunities offered you academically and hopes that you will participate in the many activities and events planned for the community of mathematicians at the University of Utah. Look for upcoming events from the Department of Mathematics and USAC announced in e-mails, bulletin boards and in the classroom.

The case is different here.

Personality!

by Roy Keir

Marilyn Keir's area of expertise is in math education. Her degrees are from the U. and from Stanford. She excelled as a teacher in Salt Lake public schools, receiving (among many other awards) the Presidential Award in Math Teaching from the older President Bush and a Woodrow Wilson Fellowship to Princeton. She has spoken at national conventions and taught a slew of workshops. One of her prize possessions is a CD of PI songs written and performed by her students at Skyline High, including "Wishing PI were somehow here again."

Marilyn has a perfect husband (who writes well, as you can see). Their three over-achieving children have so far given them four strikingly cute grandchildren. Her roots are right here in Salt Lake City, and most members of her immediate family still live here, including her mother (who just turned 90!).

Marilyn's hidden talent is belly-dancing (I have only seen her perform once). Marilyn doesn't have any spare time, she is so busy teaching, going out for coffee, gardening, searching garage sales, visiting grandchildren (in Colorado Springs, San Diego, and San Antonio), and going on cruises with me.

I can't think of anything I could tell you that would surprise those of you who work with her in the department. All I can say is that after thirty three years of marriage she still frequently surprises me.

Newest Staff Member

Kathleen Kerr joined the department on June 16, 2003, as an executive secretary. She will be working with the faculty in LCB, backing up the front desk, and helping to update our web pages. She calls Boise, Idaho, home. This past spring she completed a B.F.A. in modern dance here at the University. She loves hiking, skiing, golfing, reading, and cribbage. We welcome her and are enjoying working with her and getting to know her better.

Summer Report

Minicourse on Biological Invasions
by Fred Adler

The VIGRE minicourse entitled "The Mathematics behind Biological Invasions" was held from June 2-13, 2003. We were joined by 20 students from 10 states and 3 countries, all seeking the wisdom of primary lecturers Mark Lewis (University of Alberta) and Mike Neubert (Woods Hole Oceanographic Institution). How fast do invading species spread into a new area? What mathematical techniques are needed to translate information about the behavior of individuals into the observable effects on populations? The principle lecturers developed a remarkable array of techniques from partial differential equations, integro-difference equations, matrix models, and stochastic processes to address these questions, showing not only how to put these methods to work, but also how they are connected to each other (the deeper mathematics BEHIND the applications).

After digesting these insights and lunches at Big Ed's, the students worked together on computer exercises and problems to see whether the methods really worked (as they usually did). As an additional reality check, Lynn Bohs from our own Department of Biology led a field trip to the nearby foothills to meet some of the astonishing variety of invasive weeds. Students were challenged to distinguish native from non-native plants based on their appearance and spatial distribution, and did a generally pathetic job.

To further round out their perspective, additional speakers addressed more specific topics. Fred Adler showed his theory of the Balance of Terror and tried to convince everybody that invaders are playing a dangerous game and could be demolished by local predators. Nancy Sundell, one of our VIGRE post-docs, discussed her work on the expanding populations of snow geese in the arctic, and showing how that invasion is creating permanent changes to that ecosystem. Don Feener, from the Department of Biology, discussed the difference between invasive and "tramp" ants (such as the pavement ants we see fighting all over the Salt Lake valley). Jim Keener showed how the models of species spread are formally identical to models of spread in excitable media, and added more mathematical tofu to the feast with his discussion of the averaging theorem.

In addition to listening and participating in lectures, students broke into groups to work on more extended projects, and presented their results to the entire group on the last day. The topics ranged from sea otter invasions in California (why do otters seem to prefer to move south?) to comparison of different methods for estimating spread rates from dispersal data (does Mark Lewis' method really work?). At least one group is planning to submit their project results for publication.

Finally, participants distinguished themselves by their enthusiastic attendance of the course barbecue in Mill Creek canyon (where they chased away someone who tried to take our table, noted down the license number of the truck that ran into my car, and played some fancy hacky-sack) and the course party at Brynja Kohler's house (where they ate all the food and all left by 10:00 p.m.).

All in all, it was an exciting two weeks, and we all came away with many new friends, new understanding, and new research ideas. Many thanks to the VIGRE program, and particularly Sarah Strong, for making it all possible.

Minicourse on Waves in Inhomogenous Media
by David Dobson

July 28 through August 7, the Department of Mathematics presented a summer mini-course for graduate students on "Waves in Inhomogeneous Media". The mini-course was funded by the Department's NSF VIGRE grant. The two-week course featured principal speakers Prof. George Papanicolaou of Stanford University and Prof. William Symes of Rice University. Other speakers included Utah Math faculty members Alexander Balk, Andrej Cherkaev, Elena Cherkaev, David Dobson, Ken Golden, and Graeme Milton, as well as Jerry Schuster from the Geophysics Department. Jesse Ratzkin assisted and coordinated discussion sessions.

An exciting and broad range of topics was covered, including seismic imaging, waves in random media, water waves, inverse problems, waves in chains and lattices, waves in periodic media, properties of sea ice, rainbows, and wave behavior in composite media.

The mini-course concluded with a one-day "mini-symposium" on current research topics on waves in inhomogeneous media, which featured six speakers from research institutions across the US and Europe, as well as Tom Robbins from our own Mathematics Department.

Many University of Utah students attended the mini-course, including several from other departments, and a few Mathematics undergraduates. Eight graduate students from Universities across the country travelled to Utah to participate in the mini-course. Three postdocs also participated. This event was an unusual opportunity to learn first-hand from top experts in wave behavior. The involvement and successful interaction of such a broad range of people: undergraduates, graduate students, postdocs, and faculty members, truly embodied the VIGRE concept.

A schedule of the mini-course, including abstracts of talks, electronic versions of several presentations, and computer exercises, is available at http://www.math.utah.edu/vigre/minicourses/.

Summer High School Program

Participants in the Summer Mathematics Program for High School Students work in the computer lab.

This year's Summer Mathematics Program for High School Students, held June 9 - June 26, had 24 participants. Topics covered included number theory, knot theory, combinatorics and discrete probability, and discrete dynamical systems. Jim Carlson directed the program and taught in the mornings, while students were assisted by graduate students Maria Bell, Bob Guy, and Mindy Scott, who also taught the afternoon workshops.

REU Report
by Aaron Bertram

The goal of the REU held May 12 - June 20, 2003 was to explore the fundamentals of elliptic curves, while at the same time becoming familiar with some of the subtleties of the subject through computer experiments and further reading of the literature.

We had a total of eleven undergraduate participants - eight local (Michael Giessing, Jason Henline, Jenny Jacobs, Les Kartchner, Brian Knaeble, Joel Kramer, Collin Perschon and Michael Woodbury), two from Ohio (Eric Radke and Jenise Smalley) and one from Puerto Rico (Jose Gonzalez). The REU was run by Professors Aaron Bertram and Jim Carlson, with the assistance of VIGRE post-doc Javier Fernandez and VIGRE graduate students Nate Albin, Matt Clay, Greg Piepmeyer and Emily Putnam.

For the first four weeks, the schedule was two hours of lectures on the excellent book of Silverman-Tate (Rational Points on Elliptic Curves) in the mornings, followed by afternoon sessions on the use of Python (in emacs) in making elliptic curve computations. In addition, late-afternoon tutoring sessions with the graduate students on algebra, number theory and projec-

tive geometry were held four days a week to fill in some of the missing background.

The final two weeks consisted of some lectures on topics in elliptic curves, but mostly undergraduate presentations of solutions to important problems out of the book, computer projects and papers from the literature. Some of the most interesting projects that the students prepared included:

• A simple proof that Z_{11} is not the torsion group of an elliptic curve (this turned into an honors undergraduate thesis by Michael Woodbury).

• Computer searches for torsion groups of elliptic curves in Weierstrass normal form vs other normal forms.

• Implementation of Lenstra's factorization algorithm.

• Explanation of Benedict Gross' version of the Lucas-Lehmer test.

• Computer searches for large integer points on elliptic curves with small discriminant.

Altogether, I think the REU was a great success. The students learned a great deal of general mathematics, immediately applied to concrete elliptic curve problems. They did some very interesting computer work and several of them read and presented research papers.

Faculty News

We welcome our new faculty! The following list gives their names, specialties, and the year and place of their Ph.D.s. Introduce yourself when you bump into them, or drop in and chat with them in their offices!

New postdocs, Assistant Professor (Lecturers), are: Emmanuel Allaud (Hodge Structures, Université Paul Sabatier 2002), Daniele Arcara (Algebraic Geometry, University of Georgia 2003), Robert Bell (Topology, Ohio State University 2003), Dan Margalit (Topology, University of Chicago 2003), Sandra Spiroff (Commutative Algebra, University of Illinois-Urbana 2003), and Grady Wright (Numerical Analysis, University of Colorado-Boulder 2003).

New tenure track Assistant Professors are: Y.P. Lee (Algebraic Geometry, UC Berkeley 1999) and Ken Bromberg (Geometry, UC Berkeley 1998). Y.P. and Ken's appointments were both actually effective last year. They have been on leave and are joining us this fall.

In the area of math education we have two associate instructors joining the department on a more permanent basis. Dennis Allison and Kelly MacArthur have taught for us in the past on a part-time basis but are full-time in the department this year.

Faculty who are away from us on other business this year are: Jim Carlson, Misha Kapovich, Hugo Rossi, Grisha Mikhalkin, and Wieslawa Niziol.

Congratulations Lajos!

by Graeme Milton

I thought you might be interested to learn that Lajos Horvath has the distinction of being one of the most highly cited researchers. According to the website http://ishighlycited.com he is one of about 230 mathematicians worldwide to receive this distinction. At the University of Utah seven faculty are highly cited researchers, two from the College of Science (Peter Armentrout from Chemistry is the other one). Lajos has about 190 publications, which are clearly getting a lot of attention. Thanks go to Davar for bringing this to my attention.

Let Them Eat SPAM

by Peter Alfeld

Nowadays, for a few dollars anyone can buy CDs containing millions of email addresses. It's only one more small step to send any kind of message to all these people. If you can send out 10 million email messages at virtually no cost to you, and receive three responses that will earn a buck for you, is that a good deal? Unfortunately quite a few people think so. If you can write a program that will propagate itself through the internet and infect and paralyze thousands of computers, is that an intriguing challenge that will prove your computer prowess? Unfortunately there are people who feel that way.

You may recall my informal query last Summer about how much spam we receive. Answers ranged from "what is spam?" to "at least 100 messages a day." Typical spam messages include commercial advertisements (particularly of printer cartridges, Viagra, and various forms of pornography), viruses, plain gibberish, and fake offers to help launder huge amounts of money. A

particularly upsetting spam technique is to use legitimate email addresses as a fake sender. Sometimes these messages bounce and are sent back to the purported sender. That's how I found out that my email address is regularly used in this fashion.

The most worrisome aspect of spam is that while it may only be a nuisance today, it has the potential to paralyze email completely in the future. How to deal with this threat and how to cope with spam is a huge and difficult issue. Some technical questions are addressed elsewhere in this newsletter by Pieter Bowman.

Here are some suggestions:

• There are "services" that systematically examine web pages for email addresses, and "harvest" and sell them. To defeat these pirates don't list your email address anywhere in machine legible form, for example in the text of an html file. Instead create a gif file of your address and display the image. The computer staff or I can help you with that task. For an example, visit http://www.math.utah.edu/~alfeld/address.html .

• Do not respond to spam. In particular do not accept any offers. Either reaction will only land you on more lists and increase your spam volume.

• Consider using different email addresses for different purposes.

• Consider the use of filters.

The last two approaches work for some people in our department, but personally I find them too intrusive and bothersome. As a last resort consider changing your email address. My new address is pa@math.utah.edu, and by the time you read this newsletter, if you send a message to alfeld@math.utah.edu the system will tell you that that user is unknown. I am planning to watch like a hawk to make sure that my new address does not show up as an ordinary text string anywhere on our systems! (I found my old email address listed in about 800 departmental files.) To change your math address talk with Pieter Bowman. Any number of additional (and free) addresses can be obtained on the internet.

It's hard to relate to the mind set of individuals who think nothing of wasting the time, energy, and good will of millions of people, and spam is a difficult and growing problem. But there is a silver lining: Quite a few people responding to my survey last summer reported that they receive little or no spam. So if you are being clobbered with spam, starting with a new address, and taking precautions such as those suggested above may restore your electronic peace, at least for a while.

The Dirt on SPAM

by Pieter Bowman

What is SPAM?

It's a packaged pork product sold by the Hormel company. It's also a nickname used for unsolicited commercial email (UCE) and other types of junk email.

Where does SPAM come from?

Many places. Some from that company you bought a product from, others from places you've never heard of.

Can we track down where the SPAM comes from?

Maybe. The honest companies that are sending you information about their services almost always send from their own servers or from a direct marketing company. However, there is much SPAM which is relayed through third party systems, often without the knowledge of the third party. Many of these messages either originate in or are routed through other countries (such as Brazil, China, Korea, Mexico, Russia and others).

Forgery as part of modern email.

As part of reading email one should always be very cautious. The header lines (From:, To:, Cc:, etc.) can all be easily forged. About the only lines one can usually trust, are the top most Received: header lines. These should always show that the mail server where your account is located (eg. sunshine.math.utah.edu), received the message from someplace else (or itself). If there is something about the message which looks suspicious, one should start by checking these Received: lines. As part of the top Received: line, you may also see the email address which was used to get the message to you (also known as the envelope address).

How do the SPAMMERs get my email address?

Many different sources. If you gave your email address to the company you were doing business with, they will most likely use that address for marketing purposes. They might also sell their email address lists to their commercial partners. Companies also get email lists by buying them

from other companies which specialize in collecting email addresses. The companies which collect email addresses get them from many sources, such as web pages, public mailing lists and news groups. Another way is to take a list of common names and add known domain names (the part following the '@' in an email address).

Other types of junk email.
One of the most prevalent types of junk email is the Nigerian scam. This is a letter which says that it comes from some relative of a high-ranking official in Nigeria (and sometimes other countries), which has a bundle of money (usually in the millions of dollars) they would like to get out of their country.

Dangerous email.
There are some types of email which are dangerous. Most of these are viruses or worms which infect PCs running the Windows operating system. Often these messages use known defects in various email programs such as Microsoft Outlook and Outlook Express, though they may not be limited to just Microsoft products.

What can be done about all this SPAM?
In reality, not much. For the companies which are genuinely interested in marketing their products to interested parties, they usually will provide a valid way of removing your email address from their lists. They will often ask you at the time you are entering your email address if you would like to either opt-in or opt-out of their email lists (the opt-in/out default may not be what you expect, so read their form carefully). Sometimes using a modified email address when registering with some company will help show where someone got your address. The modified form of email address which works with the Math systems mail software is of the form "username+sometext@math.utah.edu" (eg. one might use the following when registering with the UofU Credit Union "pascal+uofucu@math.utah.edu"). Unfortunately, many web sites won't allow the special character '+' in email addresses.

For the rest of the companies out there which send spam, they may provide a URL or email address (or sometimes a phone number) for getting your email address removed from their lists, but much of the time this information is not of any value and may only succeed in keeping your address on their lists.

As a preventative measure, one should limit the places an email address can be found. Reduce, eliminate or modify email addresses on web pages. Don't send email to public mailing lists or news groups.

There are ways one can try to deal with spam email by using filters to direct incoming messages into the different mail boxes. These filters
can be handled by the software which moves the mail across the internet (Mail Transport Agent (MTA)), the software which is used to deliver the mail (Mail Delivery Agent (MDA)) or by the software each person uses to read their email (Mail User Agent (MUA)). Writing the rules which make up the filters is a difficult task, which in many ways is specific to each individual. Also, the rules may need changing often, as the email spammers send changes. The best place for such filters to be setup is in the MUA, so that each person can decide how to handle a particular type of message.

At this time, on the Math systems we don't do global filtering, because the first time that a valid email message is lost due to incorrect filtering, that is one too many messages lost.

Mathematical Morsels

Is this how we teach math???
"Being able to recognize the negation of a statement involving a quantifier is one of the most important skills in logic. For instance, consider the statement 'All dogs are brown.' In order for this statement to be false, you do not have to show that all dogs are not brown, you must simply find at least one dog that is not brown. So, the negation of the statement is 'Some dogs are brown.'" (page A45 of the third edition of Larson, Hostetler, and Heyd, Intermediate Algebra, Houghton Mifflin Co., 2001, our textbook for Math 1010.)

We've come a long way, baby
The brain of the LM (lunar module, the space craft that landed on the moon) was housed in a state-of-the-art computer with 36,864-word fixed and 2,048-word erasable memory. (Gene Kranz, former NASA Flight Director, in "Failure is not an option." This note was being typed on a computer with 2,147,483,648 words of erasable memory and an unknown amount of fixed memory.)

Euclid's Last Theorem
After a while you get to a point where you have to draw the line. (Network humor -- those Greeks did have a firm grasp of human nature.)

A Puzzle
You have an unlimited supply of matches and strings. Each string burns exactly one hour from end to end. But the strings are all different, and they burn at a speed that varies along the string, and with the string. So you can't tell the time from the current location of the flame in the interior of the string. How do you use your matches and strings to measure an interval of 45 minutes? Allegedly this is a question that used to be asked at a certain University in their Physics Ph.D. qualifying exams. Students had five minutes to figure out the answer, or they would fail. Now the question for the mathematicians: Describe the set of numbers (time intervals) that can be measured with your strings and matches.

The largest prime
The largest prime number currently known is $2^{13,466,917}-1$. It is the fifth prime number found by the Great Internet Mersenne Prime Search project (http://www.mersenne.org/prime.htm) which has tens of thousands of participants.

Math Center
The Math Center is in full swing already this year. If you haven't already mentioned it to your students, please do so. We offer drop-in and group tutoring, a drop-in computer lab, and study rooms for students in math classes. The math center is a great resource for our students, and we'd hate for any of them to miss out on getting the help they need simply because they did not know about it. For more information on the services we offer, please contact Angie Gardiner.

Upcoming Events
Monday, Sept. 8: GRE Prep Seminar organizational meeting, 3:30 PM, LCB 121

Wednesday, Sept. 17: University of Utah Math Circle begins, 4:00 - 6:00 p.m., LCB 219.

Thursday-Friday, Oct 2-3: Fall Break, no classes.

Aftermath is published monthly during the academic year. Issues of the newsletter will be archived on the web at:

www.math.utah.edu/newsletter

The Aftermath is edited by Peter Alfeld and Angie Gardiner. Please contact one of them if you have an idea or article to submit.